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A new framework for sustainable hydropower development project

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Abstract. This project studies on the establishment of a new framework for sustainable hydropower development. A hydropower development is listed as one of the prescribed activities under the Environmental Quality Order 1987. Thus, Environmental Impact Assessment (EIA) guidelines must be referred to comply with the Department of Environment (DoE) requirements. In order to execute EIA, an assessment tool that will be utilized in the final evaluation phase must be determined. The selected assessment tool that will be used is Systematic Sustainability Assessment (SSA) which is a new integrated tool to evaluate the sustainability performance. A pilot run is conducted in five different departments within the Energy Company to validate the efficiency of the SSA tool. The parameters to be evaluated are constructed aligned with the Sustainable Development Goals (SDG) to maintain the sustainability features. Consequently, the performance level of the sustainability with respect to People, Planet and Profit (3P's) is able to be discovered during evaluation phase in the hydropower development for continuous improvement.

1. Introduction

Hydropower is a globally acknowledged source of clean and green energy which responsible to supply the energy through the world. The increasing demand towards energy and global climate change led many countries include Malaysia to focus on the hydropower development in their energy sectors. However, the rapid development of the hydropower can affect the communities near the project site, the environment engaged with the hydropower development and also economy of the company. Thereon, this research is focusing on maintaining the sustainability performance within the hydropower development with respect to People, Planet and Profit factors in order to maximise the benefits of the new developments and prevented the negative impact towards environmental, social and economic aspects.

Nowadays, every single company that under the auspices of BURSA Malaysia is required to yield the sustainability reporting [1]. Thus, Systematic Sustainability Assessment (SSA) is designed in the advancing of sustainability reporting for promoting sustainability practices [2]. Most of the companies in Malaysia have implemented green practice in their organization management. However, the green practice only emphasizes the environmental aspect, and that causes other important aspects within the company seem to have overlooked [3]. Hence, Green Project Management (GPM P5) standard is introduced as one of the sustainability assessment tool to measure the sustainability practices performance comprehensively by taking into account the aspects of planet, people, profit, process and product [4].



The primary objective in this research is to evaluate the sustainability performance level within the hydropower development project in Malaysia. The specific targets to be accomplished in this research are as follows:

- To investigate the existing environmental assessments for hydropower development project.
- To design a framework for hydropower development project that complies with the environmental and social laws in Malaysia.
- To assist an organization to execute a self-assessment on sustainability in hydropower project during evaluation phase.

This study of SSA is to be explored in the area of the energy sectors to validate the efficiency of the established framework embedded with SSA tool in order to evaluate the sustainability performance of the hydropower development project. This research provides the guidelines to the Energy Company to integrate the sustainability assessment as part of the management and project development within the energy sectors.

2. Literature review

2.1. P5 Integration Matrix

Sustainability assessment is recognized as a powerful and important tool to measure the performance of sustainability in a company or industry [5]. There are various initiatives exists on tools for sustainable development. However, most of the sustainability measurement tools emphasize on environmental, economy and governance aspects. Some of the companies also implement different of sustainability indicators to evaluate the performance of economy, social and environmental separately. Thus, GPM P5 standard is introduced as an advanced alternative to measure sustainability performance thoroughly within an organization. GPM P5 standard is an integrated sustainability tool comprises of people, planet, profit, process and product. GPM P5 standard is designed to assist an organization to produce a comprehensive sustainability report regarding the sustainability performance to improve their strategies and productivity for a long-term success [4].

2.2. EIA

In Malaysia, EIA is necessary for each activity that is listed under the Environmental Quality Order 1987 [6]. Thus, EIA guidelines must be followed to assist an environmental planning of new or existing project. EIA used to minimize the environmental impacts of a proposed project by determine, predict and evaluate the potential impact zones within the project. The main aspects to be considered are the project concept and the site selection. The project proponent shall not oppose any policies or development plans of the Government of Malaysia. The site selection is investigated to ensure any development that is built on the site is not giving huge damage to the communities and the environments. A site visit is conducted to measure the potential impacts on the socioeconomic and environment aspects. Basically, the EIA report is expected at the end of the investigation which comprises of the details on the impact assessment and also the proposed measures that need to be addressed to avoid and minimize the impact on environment.

3. Methodology

The general framework for Sustainable Hydropower Development is as portrayed in Figure 1.

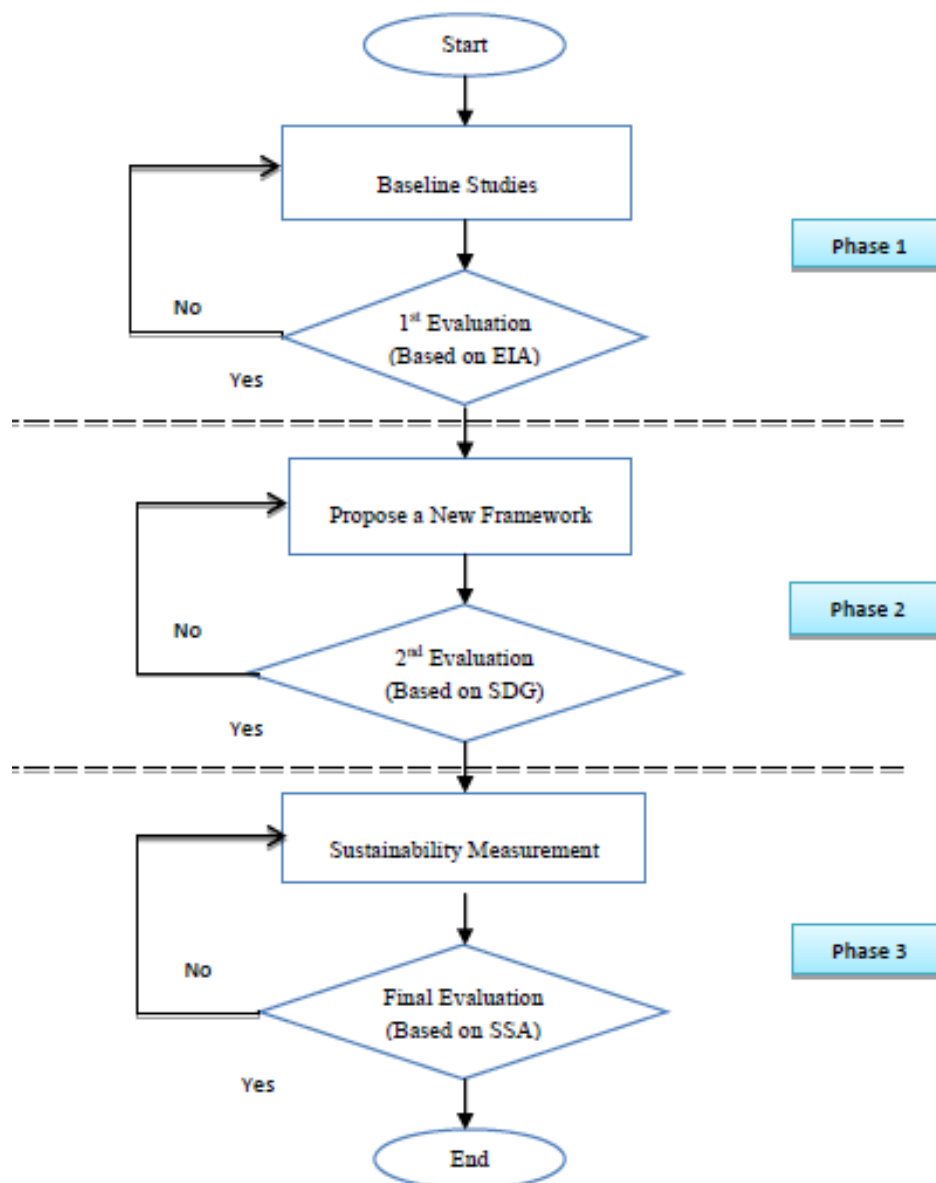


Figure 1. Framework for Sustainable Hydropower Development

The framework for sustainable hydropower development is segregated into three main phases (see Figure 1). Phase 1 consists of the baseline studies, and Phase 2 requires a proposal for a new framework. Meanwhile, the last phase which is Phase 3 relates to the sustainability measurement that will be conducted at the end of the research. Each and every phase has a different evaluation phase with different approaches such as EIA, SDG and SSA. The sustainability parameters are evaluated by scoring method where each parameter is ranked with the most suitable rating value starting from 0 to 6 (see Table 1).

Table 1. Weighting Criteria Scale from 0 to 6

Numerical Rating	Description
6	High Positive Impact
5	Medium Positive Impact
4	Low Positive Impact
3	Neutral
2	Low Negative Impact
1	Medium Negative Impact
0	High Negative Impact

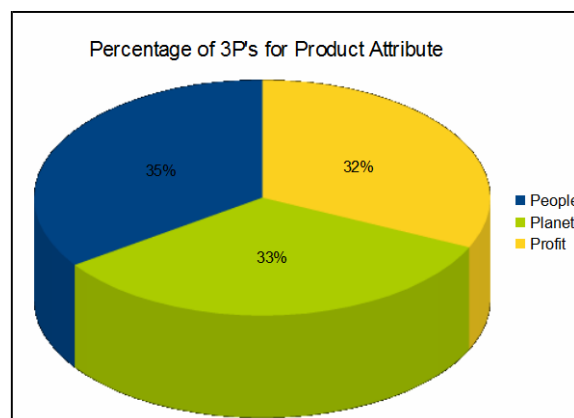
4. Results

4.1. 3P's Distribution for the Attribute

Generally, the 3P's distributions for the attribute within the entire departments are corresponding to each other. The pie chart displays the percentage of the sustainability compliance towards People, Planet, and Profit factors which are 35%, 33% and 32% (see Figure 2). The distinction of the percentage depicted in the pie chart is narrow, thus, it signifies the sustainability approach for product attribute has been complied evenly with respect to 3P's within the Energy Company.

Despite of the evenly distributions of the 3P's for the attribute; it does not imply that the sustainability approach is compiled thoroughly within the Energy Company. Overall, the Energy Company has achieved a total score of 4.46 for the mean score average which is equivalent to 74% for the mean percentage average. The average score indicates that the performance level of sustainability towards People, Planet, and Profit factors for product attribute is ranked in positive sustainability impact or precisely, lower positive sustainability impact (refer Table 1).

Although it is suggested that the sustainability approach towards 3P's has been distributed evenly, however, it does not guarantee the performance level of the sustainability compliance within the Energy Company. Altogether, the total score acquired by the Energy Company is 4.6 for the mean score average which is equivalent to 77% for the mean percentage average. The average score specifies the rank of the performance level of the sustainability towards 3P's factors for process attribute. In this case, the sustainability performance is ranked in positive sustainability impact or specifically in lower positive sustainability impact (refer Table 1).

**Figure 2.** 3P's Distribution for the Attribute

4.2. Control Chart for the Attribute

The range of each criterion is plotted on the R chart in order to measure the consistency of the sustainability variation. The R chart of the attribute is in statistical control (see Figure 3). This signifies that variation of range for each criterion is consistent between each other. On the contrary, if the point on the R chart is out of control, hence, the control limit on the X-bar chart may have tendency to be inaccurate. Although the chart is in statistical control, yet, the result does not imply the best impression as there are several points such as C1, C4, C6, C10, C11 and C12 that have a great difference between maximum and minimum values of the sustainability performance. Thus, the sustainability compliance for the criteria mentioned above must be reviewed for all five departments in order to minimize the range values for continuous improvement.

On the other hand, the average of each criterion is plotted on the X-bar chart aims to evaluate the consistency of the sustainability performance average. The X-bar chart of the Product attribute is not in statistical control as there are several points that are out of control (see Figure 3). This implies that inconsistent variation of the average value does occur between the criteria. In other words, the practice of the sustainability does not evenly distribute among the twelve criteria. The criteria such as C3, C5, C8 and C11 gain high priority to be revised in order to stabilize the sustainability compliance towards 3P's factors within the Energy Company.

Furthermore, the R chart of Process attribute also acts in the same manner as for the attribute which is in statistical control that demonstrates the consistency of range variation between each criterion (see Figure 5). However, the R chart is not in the most desirable state as there are certain points such as C2, C3, C4, C8 and C12 which have a huge gap between maximum and minimum values of the sustainability performance. Consequently, a review is required to examine the sustainability compliance for the recognized criteria within all departments to reduce the range values for a more desirable state.

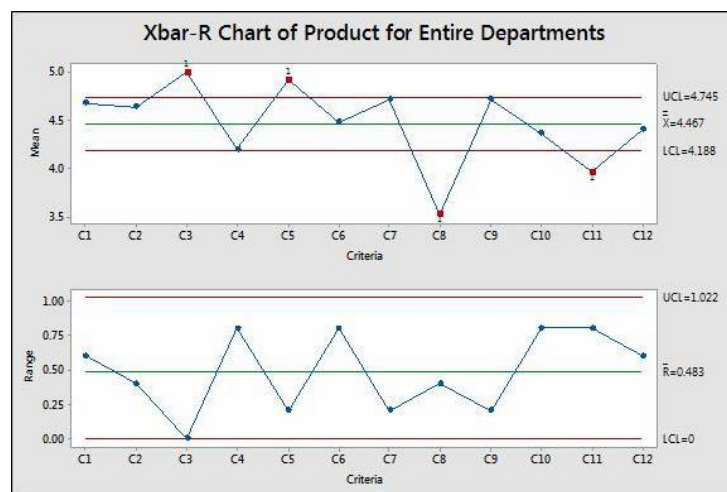


Figure 3. X-bar and R Chart for the Attribute

5. Conclusions

The outcomes from the statistical analysis portrays that the sustainability practice is not implemented thoroughly within the departments of the Energy Company. Although the company declares that all the departments within it comply with the sustainability practice, yet the statistical analysis shows oppositely. Basically, the sustainability performance of the entire departments is ranked at the positive impact of sustainability. However, further analysis shows the sustainability practice have not been adapted appropriately as the sustainability compliance is not distributed evenly among the criteria. In other words, the sustainability assessment is focusing on some criteria only and the other criteria have been neglected.

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